2009

Organic Weed Management of Primocane-Fruiting Raspberries for Iowa Growers

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Abstract
Weed accumulation in raspberry plantings is a primary concern of all producers in Iowa, especially in organic production. Tillage may be used to reduce weed growth as an alternative to herbicides in raspberry plantings. However, tillage leaves soil vulnerable to erosion and potentially depletes the nutrients and organic matter from the topsoil. Growing a living mulch on the soil surface reduces weed seed germination and growth, and reduces the need for tilling after planting between the rows of raspberry plants. Legume living mulches also can provide nitrogen compared to tilled areas and fit within the organic certification requirements. The overall objective of this research was to determine the best organically certified soil management techniques to be used in between rows in a perennial raspberry planting. Specific objectives are to determine soil management treatments' contribution to the soil's physical and chemical properties, weed growth, and raspberry growth and development.

Keywords
Horticulture

Disciplines
Agricultural Science | Agriculture | Horticulture

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Introduction

Weed accumulation in raspberry plantings is a primary concern of all producers in Iowa, especially in organic production. Tillage may be used to reduce weed growth as an alternative to herbicides in raspberry plantings. However, tillage leaves soil vulnerable to erosion and potentially depletes the nutrients and organic matter from the topsoil. Growing a living mulch on the soil surface reduces weed seed germination and growth, and reduces the need for tilling after planting between the rows of raspberry plants. Legume living mulches also can provide nitrogen compared to tilled areas and fit within the organic certification requirements. The overall objective of this research was to determine the best organically certified soil management techniques to be used in between rows in a perennial raspberry planting. Specific objectives are to determine soil management treatments' contribution to the soil's physical and chemical properties, weed growth, and raspberry growth and development.

Materials and Methods

Autumn Bliss, bare root primocane-fruiting raspberry plants, were planted May 13, 2008 at Turtle Farm, Granger, IA. Cover crops were planted May 15, 2008. The soil management techniques to influence soil properties and weed growth included 1) clean tillage every 30 days during the growing season, 2) a living mulch of *Medicago sativa* L. [alfalfa] (seed rate: 12 lb/acre), 3) a living mulch of *Trifolium repens* L. [white Dutch clover] (5 lb/acre), 4) a living mulch of *Lotus corniculatus* L. [birdsfoot trefoil] (8 lb/acre), and 5) a living mulch of *Lolium perenne* L., *Festuca sp*., and *Poa sp*. [turfgrass mix] (5 lb/acre).

Density, dry weight, and percentage cover of weed plants and percentage cover of the cover crop plants were collected in July and August. Density and dry weight of weeds were determined by harvesting weeds; roots were discarded and shoots were dried for 72h at 67^{o}C. Percentage weed cover was assessed visually as the total percentage of grass and broadleaf weed cover in the three random 50 cm × 50 cm area within each plot.

Ten soil cores (3.2 cm diameter) were collected from each plot on April 30 and November 1, 2008 to a depth of 15.2 cm. Field-moist soil cores were sieved through 8 mm mesh for bulk density, gravimetric water, and inorganic N (nitrate and ammonium) extraction and then air dried for 72h at 22–23^{o}C and used to analyze percentage stable aggregates and total N.

Results and Discussion

The percentage of living mulch cover crop in between rows of raspberries was greater in plots of white Dutch clover, birdsfoot trefoil, and alfalfa compared with plots of turfgrass mix in both July and August (Table 1). Percentage of weed cover and the number and weight of grass weeds in July were greater in plots tilled or planted to turfgrass mix or birdsfoot trefoil (Tables 1 and 2); these results reflect the environment conducive to weed growth due to the lower percentage of living mulch cover (Table 1). The number and

weight of broadleaf weeds were not different among treatments in July (Table 2). Percentage of weed cover was greater in plots of turfgrass mix and birdsfoot trefoil than plots tilled or planted to alfalfa or white Dutch clover in August (Table 1), and cover crop growth was greater in plots in August compared with July.

Soil ammonium concentration was greater in plots of alfalfa and birdsfoot trefoil compared with tillage (Table 3). Soil moisture was higher in the living mulch of alfalfa than the living mulch of clover. There were no differences in soil nitrate concentration, bulk density, and percentage aggregate stability among treatments. The soil variable total N has not yet been analyzed for treatment differences.

Establishment rate and dry weight of dormant cane prunings will be determined in spring 2009. This experiment was also repeated at the Horticulture Station and both sites will be continued in the 2009 growing season. Raspberry yield will be measured from August to October in 2009 at both sites.

Acknowledgements

We thank the College of Agriculture and Life Sciences, Practical Farmers of Iowa, On-Farm Research and Demonstration Grant Program for funding this project, and the Horticulture Station for their assistance with the project.

Table 1. Percentage cover of living mulch and weeds during treatment with tillage or living mulches of alfalfa, white Dutch clover, birdsfoot trefoil, or turfgrass in July and August 2008, Granger, IA.

	Percentage living mulch cover		Percentage weed cover	
Treatments	July	Aug.	July	Aug.
Tillage	0[z] d	0 d	87 a	24 c
Alfalfa	33 b	62 b	43 b	35 c
White Dutch clover	59 a	89 a	36 b	11 d
Birdsfoot trefoil	14 c	22 c	71 a	73 b
Turfgrass mix	4 d	0 d	80 a	87 a
LSD P ≤ 0.05[y]	12	10	17	11

[z]Means are average cover of three treatment replications.

Table 2. Number and weight of grass and broadleaf weeds during treatment with tillage or living mulches of alfalfa, white Dutch clover, birdsfoot trefoil, or turfgrass in July 2008, Granger, IA.

	Grasses		Broadleaves	
Treatments	Number	Weight	Number	Weight
Tillage	52[z] a	10.2 a	6	0.1
Alfalfa	30 ab	4.5 b	3	0.1
White Dutch clover	17 b	2.7 b	1	0.5
Bird's-foot trefoil	38 ab	8.1 a	5	0.1
Turfgrass mix	34 ab	8.2 a	4	0.1
LSD P ≤ 0.05[y]	24	3.5	NS	NS

[z]Means are average cover of three treatment replications.
[y]Least significant difference at P ≤ 0.05; NS = no significant difference; values sharing the same letter are not statistically different from each other.

Table 3. Inorganic nitrogen (nitrate and ammonium), bulk density, percentage moisture, and percentage stable aggregates during treatment with tillage or living mulches of alfalfa, white Dutch clover, birdsfoot trefoil, or turfgrass in fall 2008, Granger, IA.

Treatments	Nitrate	Ammonium	Bulk density	Moisture (%)	Stable aggregates (%)
Tillage	1.00[z]	0.07 b	1.43	15.8 ab	44.2
Alfalfa	0.84	0.68 a	1.37	17.2 a	60.4
White Dutch clover	0.65	0.37 ab	1.38	14.9 b	53.0
Birdsfoot trefoil	0.85	0.75 a	1.34	16.6 ab	62.2
Turfgrass mix	0.75	0.10 b	1.35	16.7 ab	56.4
LSD P ≤ 0.05[y]	NS	0.42	NS	1.8	NS

[z]Means are average cover of three treatment replications.
[y]Least significant difference at P ≤ 0.05; NS = no significant difference; values sharing the same letter are not statistically different from each other.